

1 1. A composition providing sustained release of a drug, the composition comprising
2 a mucopolysaccharide, a carrier protein, and a drug.

1 2. The composition of claim 1, wherein the composition consists of the
2 mucopolysaccharide, the carrier protein, the drug, and one or more pharmaceutically
3 acceptable additives.

1 3. The composition of claim 1, wherein the ratio of the total mass of
2 mucopolysaccharide in the composition to the total mass of carrier protein in the composition
3 is about 1:1 to 1:20.

1 4. The composition of claim 1, wherein the mucopolysaccharide is chondroitin
2 sulfate or hyaluronate.

1 5. The composition of claim 1, wherein the carrier protein is a γ -globulin, albumin,
2 fibrinogen, histone, protamine, gelatin, or collagen.

1 6. The composition of claim 1, wherein the carrier protein is a γ -globulin.

1 7. The composition of claim 1, wherein the carrier protein is an albumin.

1 8. The composition of claim 1, wherein the drug is a protein drug.

1 9. The composition of claim 8, wherein the protein drug is an erythropoietin,
2 granulocyte colony stimulating factor, granulocyte macrophage colony stimulating factor,
3 thrombopoietin, interferon- α , interferon- β , interferon- γ , urokinase, tissue plasminogen
4 activator, interleukin-11, fibroblast growth factor, epidermal growth factor, growth hormone,
5 brain-derived neurotrophic factor, nerve growth factor, leptin, neurotrophin-3, superoxide
6 dismutase, antibody, calcitonin, insulin, or parathyroid hormone.

1 10. The composition of claim 1, wherein the composition contains about 0.1 to 50%
2 by weight the mucopolysaccharide.

1 11. The composition of claim 1, wherein the composition contains about 0.1 to 2%
2 by weight the drug.

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1 12. A method of producing a sustained release drug composition, the method
2 comprising
3 providing a precipitating solution containing a mucopolysaccharide, a carrier protein,
4 and a drug;
5 lowering the pH of the precipitating solution to a level sufficient to form an insoluble
6 product comprising the mucopolysaccharide, the carrier protein, and the drug; and
7 collecting from the precipitating solution the insoluble product.

1 13. The method of claim 12, wherein the insoluble product consists of the
2 mucopolysaccharide, the carrier protein, the drug, and one or more pharmaceutically
3 acceptable additives.

1 14. The method of claim 12, wherein the ratio of the total mass of
2 mucopolysaccharide in the insoluble product to the total mass of carrier protein in the
3 insoluble product is about 1:1 to 1:20.

1 15. The method of claim 12, wherein the mucopolysaccharide is chondroitin sulfate
2 or hyaluronate.

1 16. The method of claim 12, wherein the carrier protein is a γ -globulin, albumin,
2 fibrinogen, histone, protamine, gelatin, or collagen.

1 17. The method of claim 12, wherein the carrier protein is a γ -globulin.

1 18. The method of claim 12, wherein the carrier protein is an albumin.

1 19. The method of claim 12, wherein the drug is a protein drug.

1 20. The method of claim 12, wherein the protein drug is an erythropoietin,
2 granulocyte colony stimulating factor, granulocyte-macrophage colony stimulating factor,
3 thrombopoietin, interferon- α , interferon- β , interferon- γ , urokinase, tissue plasminogen
4 activator, interleukin-11, fibroblast growth factor, epidermal growth factor, growth hormone,
5 brain-derived neurotrophic factor, nerve growth factor, leptin, neurotrophin-3, superoxide
6 dismutase, antibody, calcitonin, insulin, or parathyroid hormone.

1 21. The method of claim 12, wherein the pH of the solution is about 7 or above
2 before the lowering step.

1 22. The method of claim 12, wherein the pH of the solution is lowered to about 2 to 4
2 in the lowering step.

1 23. The method of claim 12, further comprising, prior to the providing step, mixing a
2 first solution containing the carrier protein and the drug with a second solution containing the
3 mucopolysaccharide to produce the precipitating solution.

1 24. The method of claim 12, wherein the precipitating solution contains zinc or
2 calcium ions.

1 25. The method of claim 12, further comprising
2 suspending the insoluble product in a preparatory solution having a pH of about 6 to 8
3 to form a mixture; and
4 lyophilizing the mixture to obtain a solid product.

1 26. A composition providing sustained release of a drug, the composition comprising
2 a mucopolysaccharide and a protein drug.

1 27. The composition of claim 26, wherein the composition consists of the
2 mucopolysaccharide, the protein drug, and one or more pharmaceutically acceptable
3 additives.

1 28. The composition of claim 26, wherein the mucopolysaccharide is chondroitin
2 sulfate or hyaluronate.

1 29. The composition of claim 26, wherein the protein drug is an erythropoietin,
2 granulocyte colony stimulating factor, granulocyte-macrophage colony stimulating factor,
3 thrombopoietin, interferon- α , interferon- β , interferon- γ , urokinase, tissue plasminogen
4 activator, interleukin-11, fibroblast growth factor, epidermal growth factor, growth hormone,
5 brain-derived neurotrophic factor, nerve growth factor, leptin, neurotrophin-3, superoxide
6 dismutase, antibody, calcitonin, insulin, or parathyroid hormone.

1 30. The composition of claim 26, wherein the composition contains about 0.1 to 50%
2 by weight the mucopolysaccharide.

1 31. The composition of claim 26, wherein the composition contains about 0.1 to 50%
2 by weight the protein drug.

1 32. A method of producing a sustained release drug composition, the method
2 comprising
3 providing a precipitating solution containing a mucopolysaccharide and a protein
4 drug;
5 lowering the pH of the precipitating solution to a level sufficient to form an insoluble
6 product comprising the mucopolysaccharide and the protein drug; and
7 collecting from the precipitating solution the insoluble product.

1 33. The method of claim 32, wherein the insoluble product consists of the
2 mucopolysaccharide, the protein drug, and one or more pharmaceutically acceptable
3 additives.

1 34. The method of claim 32, wherein the mucopolysaccharide is chondroitin sulfate
2 or hyaluronate.

1 35. The method of claim 32, wherein the protein drug is an erythropoietin,
2 granulocyte colony stimulating factor, granulocyte-macrophage colony stimulating factor,
3 thrombopoietin, interferon- α , interferon- β , interferon- γ , urokinase, tissue plasminogen
4 activator, interleukin-11, fibroblast growth factor, epidermal growth factor, growth hormone,
5 brain-derived neurotrophic factor, nerve growth factor, leptin, neurotrophin-3, superoxide
6 dismutase, antibody, calcitonin, insulin, or parathyroid hormone.

1 36. The method of claim 32, wherein the pH of the solution is about 7 or above
2 before the lowering step.

1 37. The method of claim 32, wherein the pH of the solution is lowered to about 2 to 4
2 in the lowering step.

1 38. The method of claim 32, further comprising, prior to the providing step, mixing a
2 first solution containing the protein drug with a second solution containing the
3 mucopolysaccharide to produce the precipitating solution.

1 39. The method of claim 32, wherein the precipitating solution contains zinc or
2 calcium ions.

1 40. The method of claim 32, wherein the insoluble product contains about 0.1 to 50%
2 by weight the mucopolysaccharide.

1 41. The method of claim 32, wherein the insoluble product contains about 0.1 to 50%
2 by weight the protein drug.

1 42. The method of claim 32, further comprising

2 suspending the insoluble product in a preparatory solution having a pH of about 6 to 8
3 to form a mixture; and
4 lyophilizing the mixture to obtain a solid product.

1 43. A method of delivering a drug to a subject, the method comprising introducing
2 the composition of claim 1 into the subject.

1 44. The method of claim 43, wherein the composition is introduced subcutaneously
2 or intramuscularly into the subject.

1 45. A method of delivering a drug to a subject, the method comprising introducing
2 the composition of claim 26 into the subject.

1 46. The method of claim 45, wherein the composition is introduced subcutaneously
2 or intramuscularly into the subject.